Force and Energy

I HAVE been under the impression that the supposed magnetising power of the more refrangible of the solar rays, as first examined by Mrs. Somerville in 1826, had been long ago disproved by the researches of Moser and Riess. This appears, however, to be a mistake, for I see from the report (in a recent number of the *Illustrated News*) of a lecture on Force and Energy lately delivered at the Royal Institution by Mr. Charles Brooke, F.R.S., that the lecturer is stated to have quoted the results of Mrs. Somerville's experiments to "show the interchange of light and magnetic energy."

Is it too much to ask that the editor of a popular treatise on natural philosophy will give us his authority for a statement so contrary to general scientific opinion? EXACTITUDE

Pangenesis

DOUBTLESS it is owing to a slight misprint in my communication in your number of May 11 that your correspondent, Mr. Meldola, has mistaken the gist of my objection to the theory of Pangenesis. I wrote, "a *seed* borne upon the graft would certainly be affected by the gemmules arising in the root and stem of the stock;" this was printed "a *bud* borne," &c. Now although it seems to me that much has been done to show that the stock will occasionally affect parts of the scion—and this my former letter does not for a moment contest—no evidence whatever has been brought to show that the sexual elements produced upon the scion have ever been affected by the stock without any intermediate change in the parts of the scion which may have borne the affected pollen grains or ovules.[*] And this certainly ought to be shown before it is assumed that every bud and every sexual element is formed by the aggregation of gemmules from all parts of the parents. Instead of which, in the vast majority of instances, we know that seeds borne upon the scion spring true to the scion. And if any instances to the contrary could be shown, it would then have to be proved that the part of the scion that bore the reproductive element was not a graft-hybrid. I may especially refer your readers to an interesting article by Dr. Masters, in the *Popular Science Review* for April, on "Grafting, its consequencs and effects."

A. C. RANYARD

SIR JOHN HERSCHEL

FOR nearly one hundred and fifty years Europe has not seen a more accomplished philosopher than the great and good man whose mortal remains were last week consigned to their tomb in the national mausoleum, finding there a significant resting-place close to the grave of Newton. In sorrow and friendly reverence they were followed thither by nearly all that England values as the most eminent in the various domains of those many sciences which he, through a long life, had adorned and advanced.

John Frederick William Herschel was born at Slough, in the early part of 1792, being the only son of that great philosophical astronomer, of whom it were difficult to decide, and one cares not to inquire, whether the father was or was not even more illustrious than the son. Thus the boy was nurtured within sight of that remarkable telescope, wonderful indeed for the day of its construction, which, though in reality among the least of Sir William's achievements, had probably contributed the most to render the name of Herschel famous among men. His education was conducted chiefly at home, or at all events under home influences, and mainly in the society of persons considerably advanced in years; and it is probably to this circumstance that we may attribute much of that singularly retiring, though kindly and affectionate disposition, for which he was so greatly esteemed by all who had the privilege of his acquaintance.

In 1809 he was removed to St. John's College, Cambridge, where there are still retained among a few of its oldest members some curious traditions of his scrupulous attention to the duties of his position. Certain specified selections from the "Principia" of Newton formed of course a portion of the curriculum of study; in that day they came to the student in the form of manuscripts, translated and somewhat modified from the Latin text; John Herschel, however, conceived it his duty to read the entire work just as Newton had left it. We mention this circumstance solely because it furnishes us with an early indication of that staple quality of mind without which no true greatness is ever attained, namely, thoroughness of work. It is not surprising that such a man carried off the highest honours in the University examination, and that in 1813 he graduated as Senior Wrangler of the year; the first among a little phalanx of eminent men, than whom the University of Cambridge has seen nothing superior and not much that is comparable since.

His early lot at Cambridge was cast in times of a scientific transition. To the majority of Englishmen the Continent had long been sealed, and our few men of science were for the most part unacquainted alike with the languages and with the learning of the rest of Europe; indeed, it is scarcely too much to say that the science of mathematics in England had made very little advance beyond what had been known in the later years of Newton. John Herschel, however, possessed the great advantage of living in a house where the chief languages of the Continent were understood, and in which relations with abroad were still maintained. To the late Prof. Woodhouse the honour is due of having introduced to the notice of the Cambridge mathematicians the higher methods of analysis which had long been practised on the Continent, and he was soon ably seconded in his efforts by the young mathematician. In conjunction with his friend Mr. Peacock, who afterwards became the well-known Dean of Ely, John Herschel, in the year 1816, produced a Treatise on the Differential Calculus, for the use of the University, by recasting rather than by translating a valuable work by Lacroix on that important subject, which hitherto had been studied in England solely to the most meagre extent, and encumbered by the unwieldy garb of the fluxional notation. This work was written in 1816, and before Herschel had taken his master's degree. In 1820 the translation of Lacroix was followed by another and more original work, containing a set of admirable examples and comments on almost all the more important methods of analysis by which mechanical and astronomical science had been so greatly extended by Newton's real successors, such as Euler, Lagrange, and Laplace. In this work Herschel was assisted not only by Mr. Peacock, but also by Mr. Babbage, who wrote that part of it which treated on functional equations. This admirable introduction to the higher forms of analysis is scarcely superseded even at the present day, and in some respects it remains unique. Thus John Herschel was instrumental in the promotion of that great reform in mathematical culture at Cambridge, which has never since ceased to bear most notable and excellent fruit.

It was shortly after his degree that we find the elder Herschel in one of his latest communications to the Royal Society referring with evident satisfaction to the fact that he had a son who was now capable of taking an important part in those astronomical, or rather as they may more properly be called, those cosmical researches which had formed the successful pursuit and the delight of his own life; and before his death he had the pleasure, we might not improperly call it the reward, of seeing his son in the year 1820 become one of the honorary secretaries of the newly-formed Astronomical Society. For fifty years and more he continued to be one of its most constant and loyal supporters, employing some of the last conscious moments of his life in compiling for its service a complete list, or, if we may be allowed the expression, a complete natural history of double stars, commencing with the father's first discoveries, and terminating only with the decease of the son.

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[*] I should much like to learn if the *Bizzaria orange* can be propagated by seedlings. *Cytisus Adami* is, I believe, always sterile.

Probably the busiest part, where all was busy, in the younger Herschel's laborious life, was passed between the time of his Cambridge degree in 1813 and the period when he quitted England in order to supplement the exploration of the heavens in the Southern regions, which his father had so ably commenced, if not completed, in the North. Those who have access to the Transactions of the various British scientific societies, and to the learned journals of the day, between 1816 and 1833, will be sure to find at brief intervals some important communication of his, enlarging the boundaries of human knowledge, and bearing the stamp of natural genius, cultivated and developed by honest labour. His fertility in this respect is truly amazing. Partly in conjunction with Sir James South, he re-observed the nebulæ and double stars the existence and the cosmical significance of which had first been brought to light by his father: at the same time adding to the list some thousands of celestial objects which had escaped even his sagacious observation. Like his father also he constructed his telescope with his own hands; an instrument which for many years remained a specimen, unique in its optical capacities and in the efficient simplicity of its mechanical arrangements. Latterly it has been surpassed among amateurs by Mr. Lassell and by Lord Rosse, and among artists by Mr. Grubb; but it was the Herschels who pointed the way and encouraged their successors to stand upon the shoulders of those who preceded them.

Nevertheless astronomy was very far from engrossing his whole attention; we doubt whether it absorbed even the half of it, for those who knew him best knew that the bias of his mind was mainly directed towards chemistry and light, and their cognate branches of physical inquiry. In 1819, when philosophical chemistry in England was perhaps at its lowest ebb, he rediscovered, and for the first time ascertained, the leading properties of the hyposulphite salts, the existence of which had, unknown to Herschel, been previously surmised, and only surmised, by Berthollet. In particular he noted the property of the hyposulphite of soda, whereby, as he says, "chloride of silver newly precipitated is dissolved in this salt almost as readily as sugar." We mention this circumstance because it was owing to this property of the hyposulphite alone, that Daguerre twenty years after was enabled practically to realise the hopes of Davy and Wedgwood, that the photographic pictures which they had already obtained might one day be fixed and preserved, even when submitted to the action of light. Thus, indirectly, John Herschel may, in a strong sense, be regarded as the father of photography; and at subsequent periods perhaps no man has entered more fully and philosophically into the actinic relations of light. It was during this most active period of his philosophical life that, attracted by the marvellous discoveries of Fresnel in connection with the undulatory theory of light, and after having studied and mastered what others had done before him, he set his own original powers to the task, and soon added to our knowledge fresh facts which they, his masters, had themselves overlooked. He discovered, for instance, that the relative positions of the optic axes in certain biaxal crystals were functions of the index of refraction; and he for the first time ascertained certain other actions of crystallised media on polarised light, which placed him at once among the first rank of experimental physicists of his day. The results of these studies he embodied in a most remarkable treatise on Light, published in the "Encyclopædia Metropolitana," which up to the present date may be advantageously consulted by the most accomplished student in this branch of physical inquiry. In the same great work will be found other treatises of his, on Sound, on Heat, and on Physical Astronomy, all of them bearing the stamp of genius and industry, and each one of them containing some specific advance beyond the condition in which he had found the subject.

In 1830 Dr. Lardner induced him to join in the composition of what he designated as the "Cabinet Cyclopædia," and to this Herschel contribute the two most celebrated volumes, viz., the "Preliminary Discourse on the Study of Natural Philosophy," and subsequently the volume on Astronomy. There were but few, if any, men of that day who could have contributed either. The first of them has probably formed the delight, the instruction, and the encouragement of every person who has since pursued or admired a scientific career. In dignity, purity, and pregnancy of language; in profundity of thought, in copiousness of apposite illustration, in a certain indefinable sweetness of persuasion, it, even at this day, captivates every mind that applies itself to its perusal. Here and there indeed its author gives rein to certain metaphysical speculations on Causes and Force, which are now found not exactly to square with the conceptions of later psychological writers. But on such questions as Causation and Force, a man whose mind, like John Herschel's, had been for half a century steeped in the difficult philosophy which embraces and pursues them both, may surely be more safely trusted than other minds, however subtle, whose extent of opportunity and of practical exercise have necessarily been inferior to his. We entertain a strong conviction that when metaphysical science shall, "by taking thought," have arrived at the first cubit of its stature, the deliberate conceptions of Herschel will be found to be in the main correct. A mind like his could have no sympathy with a philosophy which logically admits the thought, that, under some possible state of things, two and two can be equivalent to five. Speculative, he was by nature constrained to be such, but the practical side of his disciplined intellect sufficed to adjust the balance, and to prevent him from going deliberately wrong in his philosophy.

We now reluctantly but necessarily pass over much that is interesting and instructive in the career of the younger Herschel, and approach that crucial period of his life, when, accompanied by his wife and family, he left England for the Cape of Good Hope in 1834. To most of us John Herschel is known chiefly as the most eminent of modern philosophical astronomers; but the pursuit of astronomy was not the voluntary choice nor the chief bias of his intellectual life, it was rather the recollections and the impressions of the happy home of his youthful years, and reverence for the illustrious head of it, which determined him to complete what his father had commenced with such imperturbable diligence, and such wonderful success. He became a great astronomer, rather through filial piety than through the promptings of a natural taste. As in the case of many other great men, some of whom still survive among us, his life-long career was determined by uncontrollable circumstances, while the inborn aptitude has lain in another direction. But passing over such thoughts, suffice it to say that Herschel quitted England for a long sojourn at the Cape of Good Hope, in order to survey those portions of the sidereal heavens which were beyond the reach of his own and his father's instruments. This he did, and wisely and generously did at his own personal expense; for happily, the possession of a moderate fortune enabled him to follow his own bent, and placed him beyond the necessity of the aid and the interference of a patron. How wisely, sedulously, and successfully his time was spent in this happiest of voluntary exiles, may be gathered from the perusal of perhaps the most remarkable volume on philosophical astronomy that has yet appeared.

The publication of this volume was, however, long delayed; he therein unconsciously followed the advice of the Roman poet, "nonum prematur in annum," inasmuch as it was not given to the world as a whole until the year

1847. The truth is that the numerical calculations necessarily entailed for the reduction and the discussion of the observations, occasioned an amount of labour inconceivable to those who are strangers to the requirements of exact astronomical research, and upon all this labour he personally entered. To explain what he required, to such a mind as his, would have been more troublesome and distasteful than to do it himself. As he had done before, so he did now, and so he did again and again while consciousness was accorded to him, he laboured with his own hands. But the book itself, ultimately published by the noble and well-judged munificence of the Duke of Northumberland, is by no means a monument of industry alone; it abounds, in almost every page of its many notes and appendices, with original discoveries, suggestions, speculations, grand and comprehensive conceptions of the distribution of the celestial universe, which will require many a long year to elapse before their significance is exhausted. We may take as an illustration the first instance that occurs to us, in a suggestion, made in a note of Herschel's which might, and for a long time did, escape the reader's notice. He suggests that the main difficulty which occurs in the observation of the sun's photosphere might be removed by viewing its light when reflected from the first surface of a glass prism, which, at the same time, permits the greater part of the heat to escape away from the observer's eye. This simple contrivance, thus rapidly suggested by the way, lies at the bottom of more than one discovery which has since been made relative to the constitution of the solar photosphere; but similar instances abound.

It is hardly necessary to refer to the multiplied and well-earned honours which awaited John Herschel on his return from the Cape of Good Hope. He might have been elected to the Presidency of the Royal Society, but he retired in favour of the Duke of Sussex; and shortly afterwards, not alone for his own sake but for the substantial recognition of an illustrious name among the worthy families of his country, he was made a Baronet of the United Kingdom. Like his great predecessor Sir Isaac Newton, he might have been returned as the representative in Parliament of that noble University where his intellect was nurtured and grew, until it became its brightest and fondest ornament; this honour he declined. Subsequently he was appointed, again like Newton, to the lucrative post of the Mastership of the Mint; but his gentle and unsophisticated nature was ill adapted to cope with the occasional unrealities and difficulties of an official life; it affected his health, and he retired after a tenure of a few years.

Our space forbids us, in this place, to enter upon the more recent portions of this illustrious man's public and scientific career; indeed it cannot fail to be sufficiently known to the great majority of our readers. His true place in the philosophy, and among the great lights of his age, cannot be accurately fixed, until his own generation shall have entirely passed away; for the feelings, the partialities, the prejudices of contemporaneous life, unavoidably warp and incapacitate the judgment, just as too close a proximity to a mass or a multitude is unfavourable to a correct appreciation of its true proportions. Some time after the death of Laplace, the writer of this notice, while travelling on the Continent in company with the celebrated French *savant* Biot, ventured to put to him the question, not altogether a wise one—"And whom of all the philosophers of Europe do you regard as the most worthy successor of Laplace?" Probably no man was better able than Biot to form a correct conclusion, and the reply was more judicious than the question. It was this,—"If I did not love him so much, I should unhesitatingly say, John Herschel." It is from a loving reverence for the memory of a great philosopher and a good man that we now venture to say no more.

Out of the large number of mourning friends who last week in Westminster Abbey gazed with reverential regret at the sorrowful procession which followed the mortal remains of John Herschel, till they were deposited among the best loved and most highly honoured of the worthies of past time, not a few must have recalled to their memories how in their scientific difficulties, or anticipations, or successes, they had betaken themselves to the aged philosopher of Collingwood, and had never failed to meet with the ready aid of a kindly and courteous sympathy.

C. P.

SIR J. HERSCHEL ON OCEAN CURRENTS

WE are permitted to publish the following letter (probably one of the last written by Sir John Herschel on scientific subjects) which was addressed by him to Dr. Carpenter, with reference to his paper in the Proceedings of the Royal Geographical Society, "On the Gibraltar Current, the Gulf Stream, and the General Oceanic Circulation," a copy of which had been forwarded to him by Dr. Carpenter on its publication, with a request that he would reconsider the opinions he had formerly expressed as to the inadequacy of differences of temperature and specific gravity to produce great movements of ocean water:—

"Collingwood, April 19, 1871'

"MY DEAR SIR,—Many thanks for your paper on the Gibraltar Current and Gulf Stream.

"Assuredly, after well considering all you say, as well as the common sense of the matter, and the experience of our hot-water circulation-pipes in our green-houses, &c., there is no refusing to admit that an oceanic circulation of some sort must arise from mere heat, cold, and evaporation as *veræ causæ*, and you have brought forward with singular emphasis the more powerful action of the polar cold, or rather the more intense action, as its maximum effect is limited to a much smaller area than that of the maximum of equatorial heat.

"The action of the trade and counter-trade winds in like manner cannot be ignored; and henceforwards the question of ocean-currents will have to be studied under a two-fold point of view. The wind-currents, however, are of easier investigation. All the causes lie on the surface; none of the agencies escape our notice; the configuration of coasts, which mainly determines their direction, is patent to sight. It is otherwise with the other class of movements. They take place in the depths of the ocean; and their movements and directions and channels of concentration are limited by the configuration of the sea-bottom, which has to be studied over its whole extent by the very imperfect method of sounding.

"I am glad you succeeded in getting specimens of Mediterranean water near the place of the presumed 'salt spring of? Smyth and Wollaston, making it clear that the whole affair must have arisen from some accidental substitution of one bottle for another, or from evaporation. I never put any hearty faith in it.

"So, after all, there *is* an under-current setting outwards in the Straits of Gibraltar.

"Repeating my thanks for this interesting memoir, believe me, Dear Sir,

"Yours very truly,
"J. F. W. HERSCHEL

"Dr. W. B. Carpenter."

We congratulate Dr. Carpenter on having obtained from so eminent an authority, as one of the last acts of his honoured life, this cordial and well-considered acceptance of the doctrine he had previously opposed; and this distinct recognition of the new aspect in which Dr. Carpenter's own observations and reasonings had placed it. The success of his appeal shows that he did not underrate the noble candour of the great philosopher, to whom, more than thirty years previously, he had dedicated his first scientific treatise, as an expression of his gratitude for the moral and intellectual benefit he had derived from the "Preliminary Discourse on the Study of Natural Philosophy." We shall return to this subject next week.